

BART EARTHQUAKE SAFETY PROGRAM



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SAFETY PROGRAM**
BUILDING A STRONGER SYSTEM



Presentation Overview



- History of BART
- Earthquakes in the Bay Area
- BART's Earthquake Safety Program
- Studies Completed
- System Vulnerabilities and Potential Impacts
- Priorities, Costs and Schedules





BART – a Regional Response



Section of BART's Transbay
Tube Under Construction

“If the Bay Area is to be preserved as a fine place to live and work, a regional rapid transit system is essential to prevent total dependence on automobiles and freeways.”

-San Francisco Bay Area Rapid Transit Commission, 1951



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BART's Past



1946

Discussions
Begin

1957

BART District
Created

1962

Voters Approve
BART Plan

1964

Construction
Begins

1970

BART Car
Prototype Created

1972

BART Carries
First Passenger



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5 Lines

104 Miles

- 37 Miles on Underground Track
- 23 Miles on Aerial Track
- 44 Miles on Surface Track

4-County Service Area

- Alameda (19 Stations)
- Contra Costa (10 Stations)
- San Francisco (8 Stations)
- San Mateo (6 Stations)



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Keeping the Bay Area Moving



A Vital Transportation Link

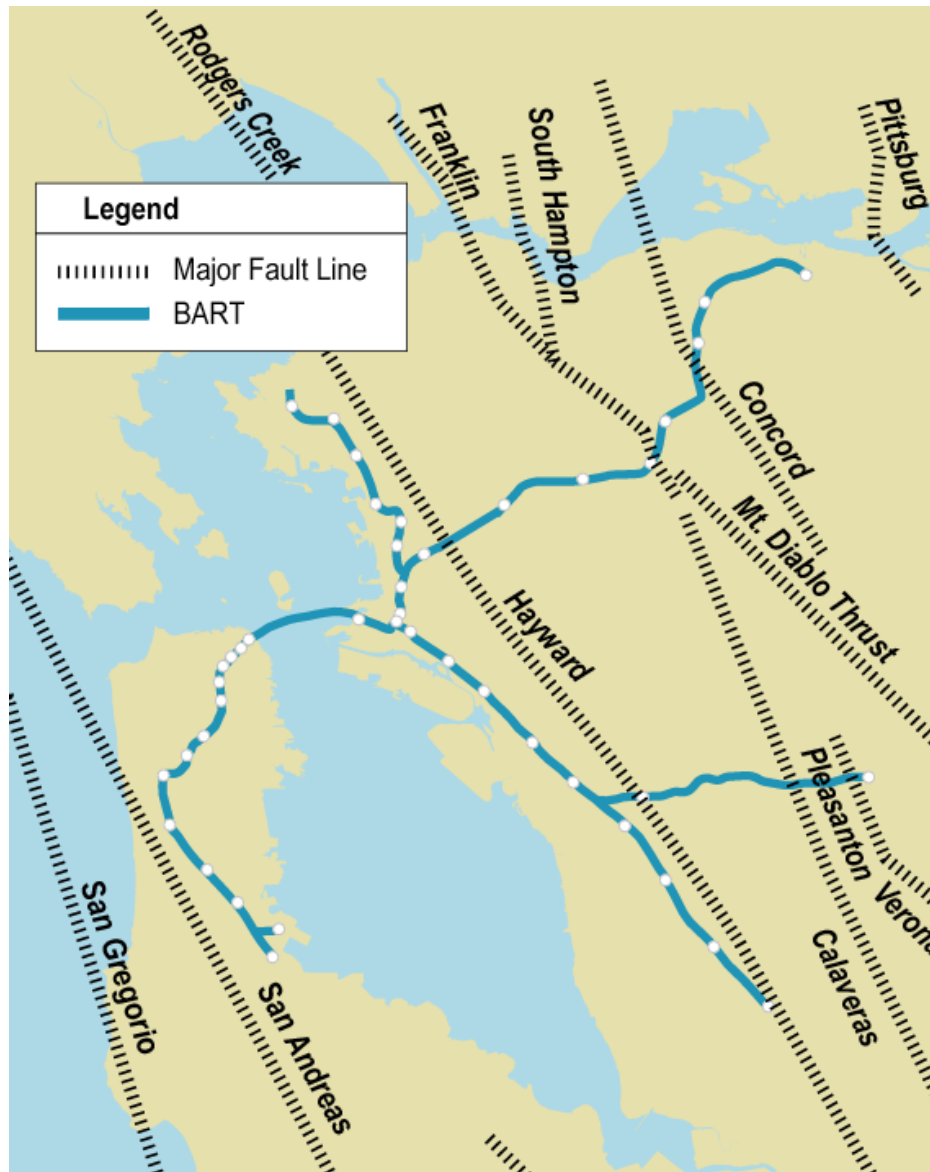
- 330,000 Daily Weekday Ridership
- 150,000 Daily Cross Bay on BART
- During Peak Commute, BART Carries as Many People as the Bay Bridge
- 26 Million Trips/Year to or from Contra Costa County
- 20 Million Trips/Year to or from Alameda County
- 49% Downtown Oakland Workers Commute on BART
- Since 1970, BART Service Enabled San Francisco to Accommodate Estimated 113,000 Jobs
- BART Riders Spend Ave. \$400 Million on Retail in San Francisco Annually



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Bay Area Faults and Earthquakes



- Major Fault Lines in BART Service Area
- Hayward Fault Parallel to BART/ Crosses BART
- **1868** Last Major Rupture of Southern Hayward Fault (130- to 170-Year Return Cycle)
- Small Earthquakes Have Little Impact on Potential for Future Earthquakes





Learning from Earthquakes



1971

San Fernando
Magnitude 6.7

1985
Mexico City
Magnitude 8.0



1989

Loma Prieta
Magnitude 6.9



1994
Northridge
Magnitude 6.7



1995

Kobe, Japan
Magnitude 6.9

San Fernando, Mexico City, and
Northridge Photos Courtesy of the
Karl V. Steinbrugge Collection
Earthquake Engineering Research Center



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1989 Loma Prieta Earthquake



Bay Bridge

- San Andreas Fault – 50 Miles South of Bay Area
- One Month Without Bay Bridge
- BART Performance Excellent
- Daily Ridership Increased from 218,000 to 350,000
- Critical Support of the Economy
- Transport of Urgent Supplies

Photo by C.E. Meyer, U.S. Geological Survey



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BART Prepares for the Future



Original System

- Higher Standards Than Required at the Time
- Then State-of-the-Art Technology – Seismically Safe

Preparing for the Future

- Studies After Loma Prieta – Operability Issues
- Need for Comprehensive Evaluation
- Creation of Earthquake Safety Program





BART's Earthquake Safety Program



- Evaluated Existing BART System Using Today's Technology
- Identified Vulnerable Portions of the System
- Developed Potential Upgrades to Strengthen the System
- Identified Most Reasonable and Cost-Effective Actions



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Vulnerability Study Findings

Potential Life Safety Issues

Primary Vulnerabilities

- Transbay Tube – Critical Link in System
- Aerial Guideways – Located Throughout System
- Stations



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Vulnerability Study Findings

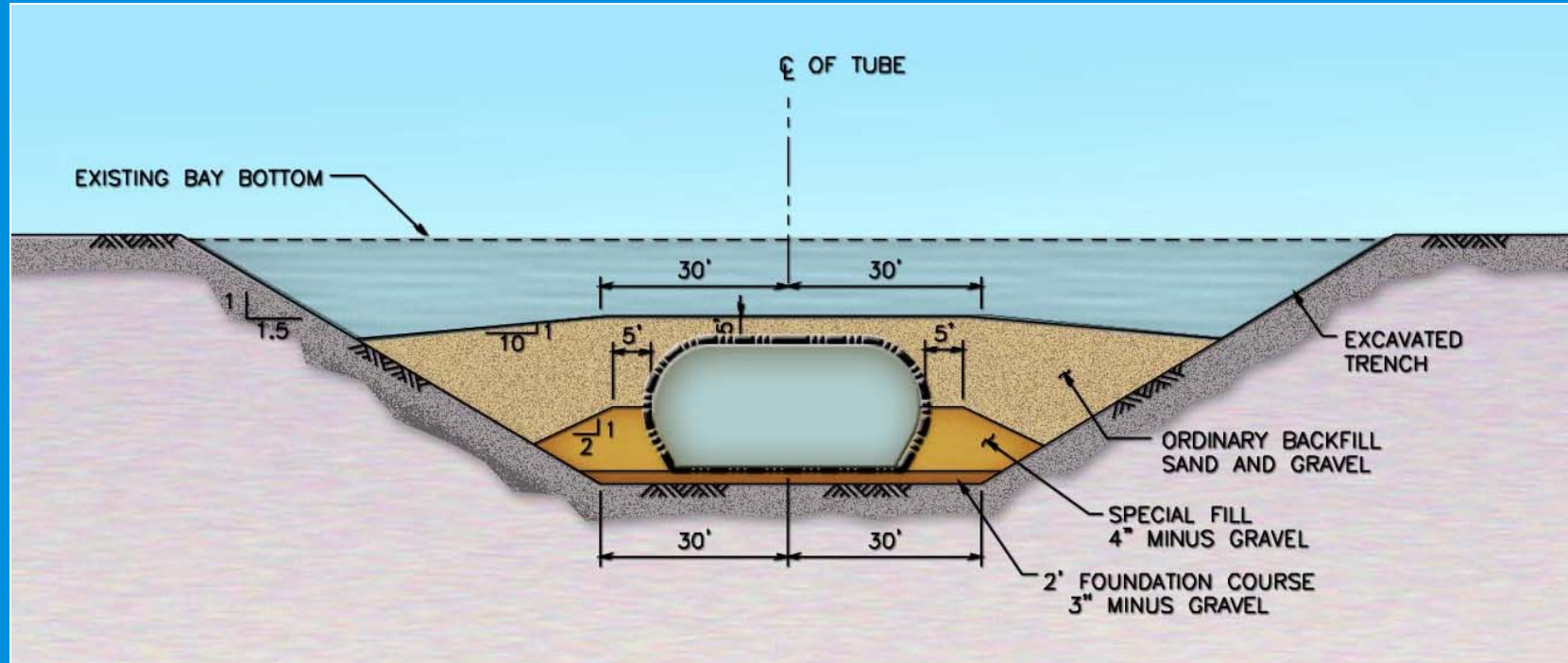


Potential Service and Traffic Impacts

- Portions of BART Could Be Closed for Repair for 2.5 Years or Longer
- 330,000 More Trips Competing for Space on a Damaged Roadway System
- During Peak, Translates to an Additional 60 to 80 Minutes Commute Delay along the Hwy 24 Corridor and Other Roadways



Transbay Tube Vulnerability



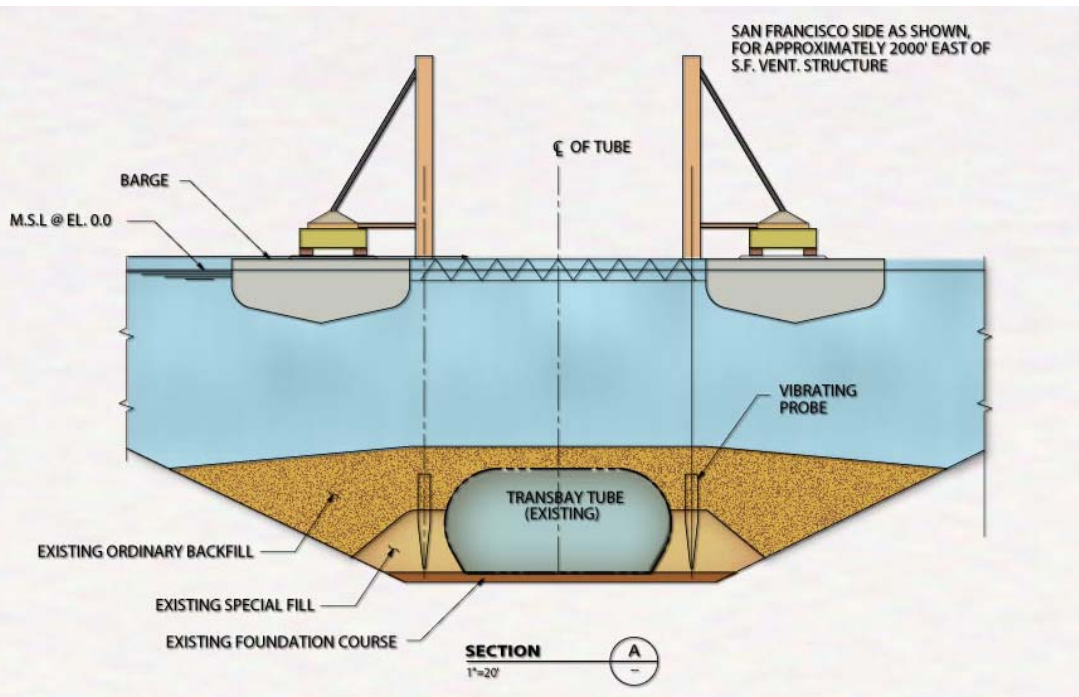
Complex System – Tube Sections, Transition Structure, Seismic Joints

- Liquefaction
- Push-Pull
- Capacity of Joints



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Transbay Tube Strengthening Concepts



Vibro-Compaction

Tube Sections – Vibro-Replacement/Compaction

San Francisco Transition Structure – Array Piles and Joint Containment

Oakland Ventilation Structure – New Concrete Shear Walls



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Aerial Guideway Vulnerability



Total of 1,918 Aerial Guideway Supports

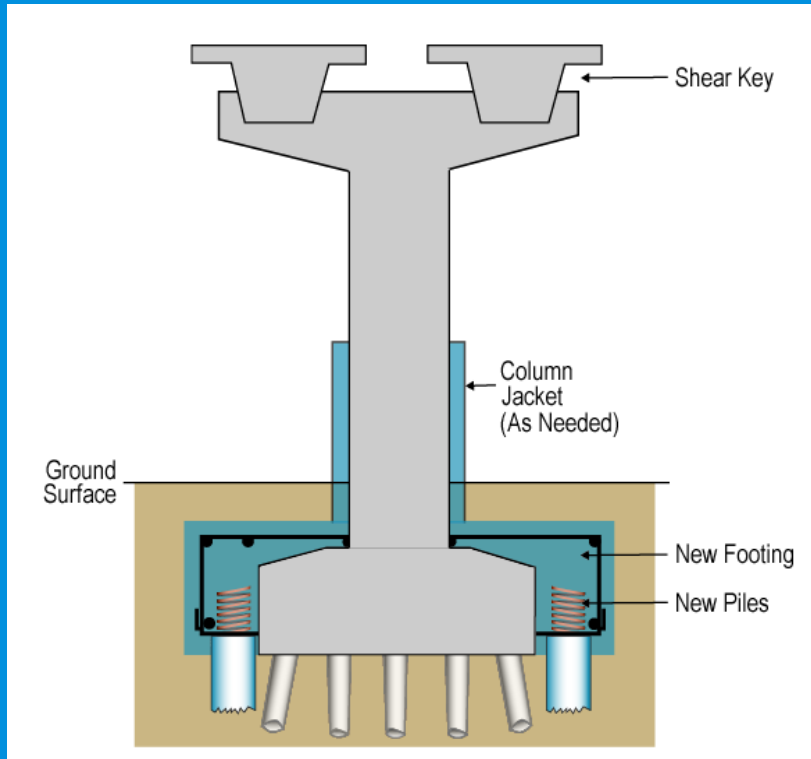
- Foundations too Small
- Potential for Crumbling of Columns, Similar to Cypress Freeway



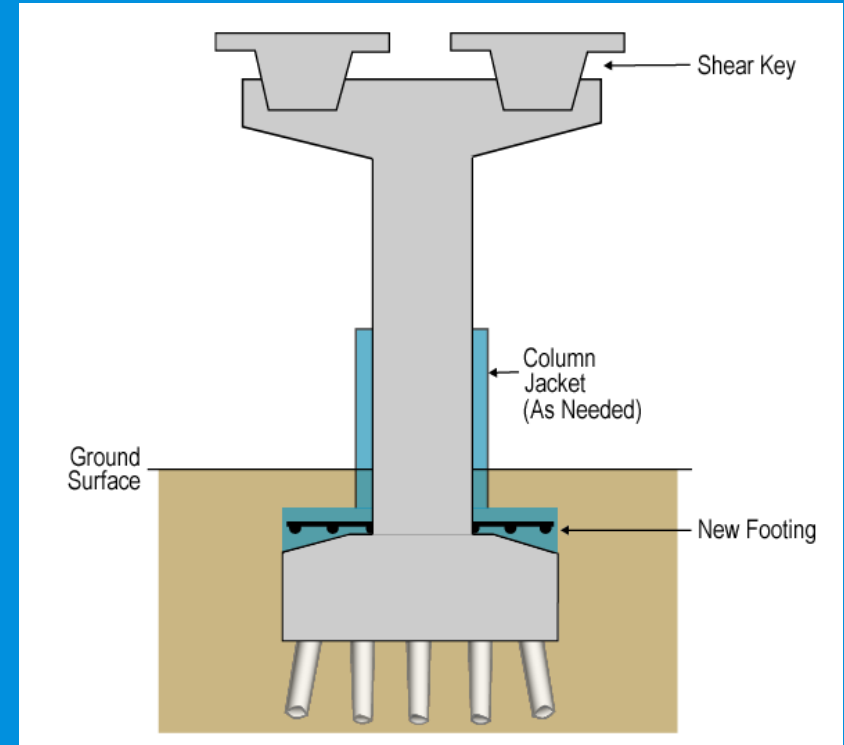
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Aerial Guideway Strengthening Concepts

Operability



Life Safety



- Strengthen Foundations
- “Jacket” Columns
- Add Shear Keys
- Add Piles (Where Appropriate)
- Similar Station Retrofits



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Two Panels of Expert Peer Reviewers

- University of California at Berkeley, Davis and San Diego
- Cornell University
- Brigham Young University
- Georgia Institute of Technology
- Virginia Polytechnic Institute
- Pacific Earthquake Engineering Center
- Earthquake Engineering Research Institute
- California State Seismic Commission
- Caltrans



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Duration and Funding Plan

10 Years to Complete Program (Depending on Funding)

BART Earthquake Safety Program Funding Plan	Amount (\$M - 2004)
Additional BART Passenger Revenues	50 M
Caltrans Local Seismic Safety Retrofit Prog	134 M
Regional Measure 2	143 M
General Obligation Bonds	980 M
PROGRAM BUDGET	\$1,307 M
Prior Funds	32 M



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Earthquake Safety – BART's Top Priority



- Save Lives
- Speed Recovery from 2.5 Years to 2 Weeks
- Protect Public Investment Conservatively Valued at \$15 Billion
- Avoid Gridlock – Keep the Economy Moving

Experts agree – earthquake safety programs are effective.



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Questions & Answers

BART is Committed to
Safeguarding Bay Area
Transportation and
Economic Well-Being



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